United States
Department of
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Soil
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NATIONAL SOIL TAXONOMY HANDBOOK
430-VI
ISSUE NO. 8

Purpose. To distribute current amendments to Soil Taxonomy, Agriculture Handbook 436.

Effective Date. These amendments and revisions are effective when received.

Filing instructions. File this copy of the changes in the 3-ring binder with Issue No. 1, 2, 3, 4, 5, and 7. It is suggested that you keep this binder with the Soil Taxonomy volume for easy reference.

Replace 615 contents dated September 1985 with the enclosed contents dated August 1986. Replace pages 615-2e and 615-2f dated September 1985 with the enclosed pages 615-2e, 615-2f, 615-2g and 615-2h dated August 1986. File pages 615.51-98 following pages 615-50.

Supplementation. States and NTC's may not supplement the handbook.

ROBERT R. SHAW
Deputy Chief
for Assessment and Planning

DIST: NSTH

CONTENTS

PART 615 - AMENDMENTS TO SOIL TAXONOMY

615.38 Low activity clay amendment

Introduction

The International Committee on Low Activity Clay soils (ICOMLAC) chaired by Dr. Frank Moormann (University of Utrecht, The Netherlands) was created in 1975 by the Soil Conservation Service to address the classification of low activity Alfisols and Ultisols. The Committee, which was open to all interested personnel both nationally and internationally, operated through circular letters which have been excerpted and published (see reference, Moormann, below). This publication provides the background material for the amendments given here. The work of the committee was also facilitated by the organization of Soil Classification Workshops funded by the Agency for International Development and organized by the Soil Management Support Services (SMSS) and the University of Puerto Rico. The proceedings of these workshops (see references) also provide background materials for the rationale to the new concepts incorporated in these amendments.

The introduction of the kandic horizon reduces many of the difficulties encountered in application of the definition of the argillic horizon. The new taxa provides a more logical place in Soil Taxonomy for many soils in the intertropical areas of the world that have properties transitional to Oxisols. It is believed that the introduction of these taxa will enhance the quality of Soil Taxonomy in its function of making and interpreting soil surveys.

The proposals of ICOMLAC have been coordinated with the discussions of the other international soil classification committees, particularly the International Committee on Oxisols (ICOMOX). The final proposal of ICOMLAC was circulated by SCS to national and international cooperators for testing, review, and comment.

References

Camargo, M. N. and F. H. Beinroth. 1978. Proceedings First International Soil Classification Workshop. Publ. EMBRAPA, Brazil. 376p.

Beinroth, F. H. and S. Panichapong. 1979. Proceedings of Second International Soil Classification Workshop. Vols. I and II. Publ. Land Development Department, Bangkok, Thailand. Vol. I - 345p.; Vol. II - 431p.

Beinroth, F. H., H. Neel, and H. Eswaran. 1983. Proceedings of Fourth International Soil Classification Workshop. Vols. I and II. Publ. Belgiun Technical Asst. Program, Brussels, Belgiun. Vol. I - 518p.; Vol. II - 175p.

Moormann, F. R. 1985. Excerpts from the Circular Letters of ICOMLAC. Technical Monograph No. 8. Soil Management Support Services, Washington, D.C. 228p.

(a) The following changes in Soil Taxonomy will accomodate this amendment.

Page 27, second column, preceding Agric horizon, add:
"KANDIC HORIZON

Genesis

A kandic horizon is a subsurface horizon with a significantly higher percentage of clay than the overlying horizon or horizons and has a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al). The clay size fraction is composed predominantly of 1:1 layer silicate clays, mainly kaolinite, with varying amounts of oxy-hydroxides of iron and aluminum. Clay skins may or may not be present. (The percentage of clay is measured by the pipette method or 2.5 times 15-bar water, whichever is higher but not more than 100.)

The textural differentiation in pedons with kandic horizons may result from one or more processes acting simultaneously or sequentially, affecting surface horizons, subsurface horizons, or both. These processes are not all clearly understood, although the most important ones can be summarized as follows:

1. Clay eluviation and illuviation

In some soils it is often difficult to find clear evidence, even by micromorphological analysis, that the higher clay content in the B horizon is a result of accumulation by illuviation of layer silicate clays. Specifically, clay skins (cutans) may be completely absent, or they may be present only at depths below the control section used in classification. In other soils, clay skins may have been destroyed by biological activity or pedoturbation processes. High concentrations and strong activity of soil fauna in soils of tropical and subtropical areas, where kandic horizons are common, may cause the partial or total disappearance of clay skins over time and to a considerable depth.

Many of the soils with kandic horizons, that have probably formed by illuvial processes, occur on stable geomorphic surfaces. On stable surfaces, the illuviation process may no longer be operative, or at least acting so slowly that mixing by soil organisms is more rapid than the formation of

clay skins. Under these conditions, clay skins may be found in some pedons but not in other nearby pedons which otherwise have similar morphology. Even within the same horizon of a single pedon, some peds may have clay skins while others do not.

2. Clay destruction in the epipedon

Weathering of layer silicates may lead to a relative loss of clay in soils. The loss is usually greatest in the upper horizons where weathering processes are most intense. Elimination of bases and some silica is enhanced by high surface soil temperatures in well drained soils with high rates of leaching. Because this process affects surface horizons more than subsoil horizons, a vertical textural differentiation may result. This may also explain the absence of clay skins in the lower horizons of highly weathered soils on old stable surfaces. A related process, that occurs in surface horizons that are periodically wet, may also result in similar textural differentiation.

3. Selective erosion

Raindrop splash and subsequent surface soil erosion cause the smallest soil particles to be moved farther downslope than larger particles. Eventually, part of the fine fraction m y be eliminated from the surface layer of sloping soils, leaving a coarser textured surface layer. The speed of this process depends on many factors, but in climates with highly erosive rains, or on soils with little plant cover, it may be very rapid. The surficial movement of clay downslope seems to be widespread and selective erosion probably is a major process leading to textural differentiation. The process appears to be enhanced by periodic fire or intermittent cultivation as practiced for thousands of years of shifting cultivation in areas where these soils occur.

4. Sedimentation of coarse textured surface materials

Lithologic discontinuities are probable on stable landscap s in many intertropical areas. In many of the soils of these areas, the surface layer is coarser textured than the subsoil, but due to the fact that all the soil material is highly weathered, stratification is not evident. If the finer textured subsoil fulfills the requirements of the kandic horizon and the surface layer is not composed of fine strata of recent material, the subsoil horizon is classified as a kandic horizon.

Significance to soil classification

The kandic horizon provides a basis for differentiation among soils with clay accumulation in the subsoil. The argillic horizon alone does not provide an adequate diagnostic

criterion to differentiate all Ultisols and Alfisols from Oxisols and Inceptisols. The kandic horizon is a diagnostic horizon that separates Ultisols and Alfisols in which the clay fraction has clay minerals with low CEC, comparable to Oxisols, from Ultisols and Alfisols with clay minerals of high CEC. Textural differentiation in most low activity clay soils by itself is believed to be sufficiently important for the understanding of soil development and use and should be recognized at a high level of the classification system. However in soils with clayey surface textures, the textural differentiation loses much of its significance. Most low activity clay (LAC) soils that have, after mixing the upper 18 cm of the soil, more than 40 percent clay in the surface horizon will be Oxisols (after the ICOMOX proposal is approved), although a few with LAC and necessary clay increase for an argillic or kandic horizon, but have significant amounts of weatherable minerals, will remain kandi Ultisols or Alfisols. It is also possible that a few with a more gradual clay increase and with a higher weatherable mineral content in the coarser fractions could be Inceptisols or pale Alfisols or Ultisols.

The presence of a kandic horizon indicates a high degree of weathering of the mineral soil material such as that in soils on old surfaces where weathering has taken place under warm climatic conditions with moderate to high precipitation. The high degree of weathering is reflected by a dominance of 1:1 layer silicate clays and oxy-hydroxides of iron and aluminum although small amounts of 2:1 layer silicate clays may also be present. There is a general absence of short-range order minerals such as allophane or immogolite. The composition of the 0.02 to 0.2 mm fraction does not always reflect the same degree of weathering, especially in soils formed in weathering products of crystalline rocks. Thus, no weatherable mineral content is specified in the kandic horizon definition.

Identification

The kandic horizon is a vertically continuous subsurface horizon (not composed of lamellae) with a significantly finer texture than the overlying horizon or horizons. It may underlie an ochric, umbric, anthropic, or mollic epipedon. The upper boundary normally is clear or gradual, although it may be abrupt, but is never diffuse. The increase in clay content is reached within a vertical distance of 15 cm or less.

The top of the kandic horizon is within one of the following depths:

a. If the particle-size class throughout the upper 100 cm is sandy, the upper boundary is at a depth between 100 cm and 200 cm from the soil surface in most of the pedon.

b. If the clay content of the surface horizon is less than 20 percent and the particle-size class (of part or all of the upper 100 cm) is finer than sandy, the upper boundary is at a depth of less than 125 cm from the soil surface.

c. If the clay content of the surface horizon is 20 percent or more, the upper boundary is at a depth of less than 100 cm from the mineral soil surface.

It is intended to exclude from the kandic horizon textures coarser than loamy very fine sand. The presence or absence of clay skins, by field examination, or cutans in thin sections, is not a differentiating characteristic for kandic horizons.

Other field characteristics of kandic horizons are not normally diagnostic, since these horizons may have properties of the argillic, the cambic, or the oxic horizon. Some soils with kandic horizons resemble those with argillic horizons in that they have a well developed subangular blocky structure, while bleached grains of sand and silt may be present in the overlying coarser textured horizon(s). The ratio of fine clay (particles smaller than 0.2 um) to total clay may be larger in the kandic horizon than in the overlying coarser horizon(s) but is not diagnostic.

Other kandic horizons have one or more properties of the oxic horizon and they would be called an oxic horizon except for the distinct clay content increase at the upper boundary. This rationale is comparable to pedons dominated by more active clays where an argillic horizon occurs that would have been called a cambic horizon except for the clay content increase at the upper boundary.

A kandic horizon is not overlain by layers more than 30 cm thick which show fine stratification and/or have organic carbon contents which decrease irregularly with depth unless it is a buried horizon. The kandic horizon also does not show fine stratification and/or have organic carbon contents

Summary of properties

The kandic horizon:

1. Is a vertically continuous subsurface horizon and has, starting at the point where the clay increase requirements are met, a CEC of $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases

soil surface, then the thickness of the kandic horizon is at least 60 percent of the vertical distance between 18 cm and

4. Underlies a coarser textured surface horizon. The minimum thickness of the surface horizon is 18 cm after

horizon is abrupt and if there is no lithic, paralithic, or petroferric contact within 50 cm.

5. Has more total clay than the overlying coarser textured surface horizon and the increased clay content is reached within a vertical distance of 15 cm or less as follows:

a. If the surface horizon as defined above has less than 20 percent total clay, the kandic horizon begins where some subhorizon contains at least 4 percent more clay absolute than the overlying horizon.

b. If the surface horizon as defined above has 20 to 40 percent total clay the kandic horizon begins where some subhorizon has at least 1.2 times more clay than the overlying horizon.

c. If the surface horizon as defined above has more than 40 percent total clay, the kandic horizon begins where some subhorizon has at least 8 percent more clay absolute than the overlying horizon.

Humults, following Haplohumults, add: "Kandihumults and Kanhaplohumults"

Humults, delete: "Palehumults"

Humults, delete: "Tropohumults"

Udults, following Hapludults, add: "Kandiudults and Kanhapludults"

Udults, delete: "Tropudults"

Ustults, following Haplustults, add: "Kandiustults and Kanhaplustults"

Page 89, Table 10, Formative elements, following Hydr, add: "Kand---- Modified from kandite----- (omit mnemonicon)-- 1:1 layer silicate clays"

Page 92, second column, item C.2., change to read: "...do not have either an argillic, kandic, or natric horizon..."

Item F.1., change to read: "Have an argillic or kandic horizon..."

Item F.1.a., change to read: "If the argillic or kandic horizon..."

Item F.1.a.(1), change to read: "...the argillic or kandic horizon..."

Item F.1.b., change to read: "If the argillic or kandic horizon..."

Item F.2.a., change to read: "...an argillic or kandic horizon or has clay...or underlies an argillic or kandic horizon; and"

Items G.1. and G.2.a., change to read: "...an argillic, kandic or a natric horizon,..."

Page 93, first column, line 3, change to read: "If there is no argillic, kandic, or natric horizon,..."

Second column, item H.1., change to read: "Have a argillic, kandic, or natric horizon..."

Second column, items H.2.a. and H.2.b., change to read: "...an argillic or kandic horizon; or"

Page 95, first column, line 2, change to read: "...an argillic or kandic horizon,..."

615.38(a)

First column, line 37,Definition, item 1.a., change to read: "...have an argillic, kandic, or natric horizon..."

Second column, line 4, Definition, item 1.a.(3), change to read: "...argillic or kandic horizon..."

Second column, line 10, 1.a.(3), change to read: "...of the argillic or kandic horizon..."

Second column, line 13, 1.a.(3), change to read: "...if the argillic or kandic horizon..."

Second column, line 23, item 1.b., change to read: "...an argillic or kandic horizon..."

Page 96, first column, lines 12 and 14, items 5 and 6., change to read: "...overlying an argillic or kandic horizon..."

First column, line 56, item 5.a., change to read: "...overlying the argillic or kandic horizon; or"

Second column, line 13, item 7.c.(1), change to read: "...and the argillic or kandic horizon..."

Line 20, item 7.c.(1)(a), change to read: "...of the argillic or kandic horizon..."

Line 24, item 7.c.(2), change to read: "...the argillic or kandic horizon..."

Line 34, item 7.c.(2)(a), change to read: "...the argillic or kandic horizon..."

Page 109, first column, lines 5 & 7, item 1., change to read: "...the argillic or kandic horizon..."

First column, line 10, item HA.2., change to read: "...the argillic or kandic horizon..."

First column, line 22, item HC.3., change to read: "...the argillic or kandic horizon..."

First column, line 43, Aqualfs, change to read: "...below the argillic or kandic horizon..."

Second column, line 18, Definition, item (2)a., change to read: "An argillic or kandic horizon..."

Second column, line 21, footnote, change footnote 3 to read: "...the argillic or kandic horizon..."

Second column, line 23, Definition, item (2)b., change to read: "...the argillic or kandic horizon..."

Second column, Key to great groups, item HAA., change "1.25 m" to "150 cm"

Delete item "HAD..."

Change item "HAE" to "HAD"

Add: "HAE. Other Aqualfs that have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm.

Kandiaqualfs, p. 114"

Page 110, first column, Definition, item 3., change to read: "...duripan, kandic horizon, or natric horizon;"

Item 4., delete item 4 and renumber 5 as 4.

Line 19, item 5., change "1.25 m" to "150 cm".

Page 112, second column, last line, Definition, change to read: "Glossaqualfs are the Aqualfs that do not have a fragipan, duripan, kandic horizon, or natric horizon but that have an albic horizon tonguing into an argillic horizon."

Page 113, first column, delete item 2.

Page 114, first column, preceding Natraqualfs add:
"Kandiaqualfs

Definition

Kandiaqualfs are the Aqualfs that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm; and

2. Do not have a natric horizon, duripan, or fragipan and do not have plinthite that forms a continuous phase or constitutes half or more of the matrix within some subhorizon between 30 cm and 150 cm below the surface of the soil.

Distinctions between Typic Kandiaqualfs and other subgroups

Typic Kandiaqualfs are the Kandiaqualfs that:

a. Have in 60 percent or more of the matrix in all subhorizons between the A or Ap horizon and a depth of 75 cm one or more of the following:

1. If mottled and the mean annual soil temperature is lower than 15° C, has chroma, moist, of 2 or less;

2. If mottled and the mean annual soil temperature is 15° C or more:

a. If the hue is 2.5Y or redder and the value, moist, is more than 5, the chroma, moist, is 2 or less;

b. If the hue is 2.5Y or redder and the value, moist, is 5 or less, the chroma, moist, is 1 or less;

c. If the hue is yellower than 2.5Y, the chroma, moist, is 2 or less;

3. The chroma, moist, is 1 or less whether mottled or not;

b. Have an Ap horizon that has either a color value, moist, of 4 or more or a color value, dry, or 6 or more after the soil has been crushed; or the upper soil to a depth of 18 cm, after mixing, has these color values;

c. Do not have an epipedon that is 50 cm to 100 cm thick if the particle-size class is sandy throughout;

d. Do not have an epipedon that is >100 cm thick if the particle-size class is sandy throughout: and

e. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume.

Aeric Kandiaqualfs are like Typic Kandiaqualfs except for a.

Aeric Umbric Kandiaqualfs are like Typic Kandiaqualfs except for a and b.

for c, with or without a.

Grossarenic Kandiaqualfs are like Typic Kandiaqualfs except for d, with or without a.

Plinthic Kandiaqualfs are like Typic Kandiaqualfs except for e.

Umbric Kandiaqualfs are like Typic Kandiaqualfs except for b.

Page 115, first column, definition Ochraqualfs, item 1., change to read: "...fragipan, kandic horizon, natric horizon..."

Second column, definition Ochraqualfs, delete item 4.

Page 117, second column, line 5, change "1.25 m" to "150 cm".

Second column, delete: "Tropaqualfs...(continuing on page 118)"

Second column, Key to great groups, item HEG.3., change to read: "...within a depth of 150 cm from the soil surface or or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer

Second column, Key to great groups, item HEG., delete item 1. and renumber 2, 3, and 4 as 1, 2, and 3.

Key to great groups, change: "HEG" to "HEI", "HEH" to "HEJ", delete "HEI" and change "HEJ" to "HEK".

Second column Key to great groups, add:
"HEG. Other Udalfs that
1. Have a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;
2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface; and
3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.
Kandiudalfs, p. 133

HEH. Other Udalfs that have a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;
Kanhapludalfs, p. 133"

Key to great groups, Rhodudalfs, change to read: "... a color value moist of less than 3.5,..."

Page 126, first column, definition Ferrudalfs, delete: "item 5."

Page 128, second column, definition Glossudalfs, delete: "item 3." and renumber 4 as 3.

Page 129, second column, definition Hapludalfs, item 2, change to read: "Have an argillic horizon that has in some

part a hue of 5YR or yellower, a color value, moist of 3.5 or

Second column, definition Hapludalfs, item 3., change to read: "...fragipan, kandic horizon, natric horizon, or..."

Second column, definition Hapludalfs, item 4.d., change to read: "There is less than 5 percent of the volume consisting of skeletans on faces of peds in the layer in which the amount of clay decreases and there is less than 3 percent (absolute) increase in clay below the layer.

Page 133, first column, preceding Natrudalfs, add:

"Kandiudalfs"

Definition

Kandiudalfs are the Udalfs that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic, or petroferric contact within 1.5m;

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer;

4. Do not have an agric or natric horizon, or fragipan;

5. Do not have, in the argillic horizon, discrete nodules 2.5 to 30 cm in diameter whose exteriors are enriched, weakly cemented with iron, and have redder hue or stronger chroma than the interior of nodules; and

6. Do not have tongues of albic materials in the argillic horizon.

Distinctions between Typic Kandiudalfs and other subgroups

Typic Kandiudalfs are the Kandiudalfs that:

a. Do not have mottles that have chroma of 2 or less within 75 cm of the soil surface if the mottled horizon is saturated with water at some time when the soil temperature at that depth is 5° C or higher or the soil has artificial drainage;

b. Do not have an epipedon that is 50 cm to 100 cm thick if the particle-size class is sandy throughout;

c. Do not have an epipedon that is >100 cm thick if the particle-size class is sandy throughout;

d. Have an Ap horizon that has either a color value, moist, of 4 or more or a color value, dry, or 6 or more after the soil has been crushed, or the upper soil to a depth of 18 cm, after mixing, has these color values;

value, moist, that is less than the value, dry, by more than one unit unless the hue in some part of the argillic or kandic horizon is 5YR or yellower; and

f. Do not have a horizon within 150 cm of the surface that has >5 percent plinthite by volume.

Aquic Kandiudalfs are like Typic Kandiudalfs except for a, with or without d.

Arenic Kandiudalfs are like Typic Kandiudalfs except for b.

Arenic Plinthic Kandiudalfs are like Typic Kandiudalfs except for b and f.

Grossarenic Kandiudalfs are like Typic Kandiudalfs except for c.

Grossarenic Plinthic Kandiudalfs are like Typic Kandiudalfs except for c and f.

Mollic Kandiudalfs are like Typic Kandiudalfs except for d.

Plinthaquic Kandiudalfs are like Typic Kandiudalfs except for a and f.

Plinthic Kandiudalfs are like Typic Kandiudalfs except for f.

Rhodic Kandiudalfs are like Typic Kandiudalfs except for d and e.

Kanhapludalfs

Definition

Kanhapludalfs are the Udalfs that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Have a clay distribution such that the content of clay decreases from its maximum amount by 20 percent or more within a depth of 150 cm from the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer;

3. Do not have an agric or natric horizon or a fragipan;

4. Do not have, in the argillic horizon, discrete nodules 2.5 to 30 cm in diameter whose exteriors are enriched, weakly cemented with iron, and have redder hue or stronger chroma than the interiors of nodules; and

5. Do not have tongues of albic materials in the argillic horizon.

Distinctions between Typic Kanhapludalfs and other subgroups

Typic Kanhapludalfs are the Kanhapludalfs that

a. Do not have mottles that have chroma of 2 or less within 75 cm of the soil surface if the mottled horizons are saturated with water at some time when the soil temperature at that depth is 5° C or higher or the soil has artificial drainage;

b. Do not have a lithic contact within 50 cm of the soil surface; and

c. Have an argillic or a kandic horizon that has a color value, dry, of 5 or more in some subhorizon or a color value, moist, that is less than the value, dry, by more than 1 unit, unless the hue in some part of the argillic or kandic horizon is 5YR or yellower.

Aquic Kanhapludalfs are like Typic Kanhapludalfs except for a.

Lithic Kanhapludalfs are like Typic Kanhapludalfs except for b.

Rhodic Kanhapludalfs are like Typic Kanhapludalfs except for c."

Page 134, first column, definition (Paleudalfs), item 2., change to read: "Do not have a kandic, natric, or..."

First column, definition (Paleudalfs), item 3., change to read: "...depth of 150 cm from the soil surface, or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer" [delete 3.(a) and 3.(b)];

Definition (Paleudalfs), delete item 1. and renumber 2, 3, 4, and 5 as 1, 2, 3, and 4.

Distinctions between Typic Paleudalfs and other subgroups, item c., change to read: "...color value, moist of 3.5 or more or a color value, dry, more than 1 unit higher than the value, moist, or the upper soil to a depth of 18 cm, after mixing, has these colors;"

Item d., change to read: "Have an argillic horizon that has a color value, dry, of 4.5 or more in some..."

Page 134, second column, Description of subgroups, Typic Paleudalfs, change to read: "...The argillic horizon has a color value, dry, of 4.5 or more..."

Page 136, first column, Rhodic Paleudalfs, change to read: "...argillic horizon have a color value, moist, less than 3.5 and...In addition, the Ap horizon or the upper soil to a depth of 18 cm, after mixing, normally has a color value, moist, less than 3.5 and a value, dry, no more than 1 unit higher than the value, moist. These soils were...."

First and second columns, delete: "Tropudalfs..."

Page 137, first and second columns, continue deleting Tropudalfs.

Second column, line 18, change to read: "...the argillic or kandic horizon..."

Line 52, change to read: "...the argillic or kandic horizon..."

Page 138, first column, Key to Great Groups, Plinthustalfs, item HCB, change "1.25 m" to "150 cm"

Key to great groups add following HCC:

"HCD. Other Ustalfs that:

1. Have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extract d with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic or petroferric contact within 150 cm of the soil surface; and

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Kandiustalfs, p. 141

HCE. Other Ustalfs that have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm.

Kanhaplustalfs, p. 141

Paleustalfs, item 1.a., change to read: "...a depth of 150 cm from the soil surface, or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer; and"

Rhodustalfs, change to read:"...a color value, moist, less than 3.5, and a..."

Change "HCD" to "HCF", "HCE" to "HCG", and "HCF" to "HCH".

615.38(a)

Second column, definition Hapludalfs, item 1., change to read: "...do not have a kandic or natric horizon..."

Second column, definition Hapludalfs, item 6.a.(3),

Second column, definition Hapludalfs, item 6.a., add item 6.a.(4) to read: "(4) There is less than 5 percent of the volume consisting of skeletans on faces of peds in the layer in which the amount of clay decreases and there is less than 3 percent (absolute) increase in clay below the layer; and"

Page 139, first column, distinctions between Typic Hapludalfs and other subgroups, item d., change to read: "....per 100 g clay (by 1N NH_4OAc pH 7);" (Delete remainder of item d.)

Second column, delete Oxic Hapludalfs and following Aridic Hapludalfs add: "Kanhaplic Hapludalfs are like Typic Hapludalfs except for d, with or without g or f, or both."

Page 140, second column, description of subgroups, change Oxic Hapludalfs to Kanhaplic Hapludalfs and change to read: "...cation-exchange capacity (by 1N NH_4OAc pH 7) of <24 meq per 100 g clay. They are also permitted...", and move to precede Lithic Hapudalfs

Page 141, first column, preceding Natrudalfs, add:

"Kandiudalfs"

Definition

Kandiudalfs are the Udalfs that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic, or petroferric contact within 150 cm and do not have a duripan within 100 cm of the soil surface;

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of

Distinctions between Typic Kandiustalfs and other subgroups

Typic Kandiustalfs are the Kandiustalfs that,

a. Do not have mottles that have chroma of 2 or less within 75 cm of the soil surface if the mottled horizon is saturated with water at some time of the year when the soil temperature at that depth is 5° C or higher or the soil has artificial drainage;

b. Do not have an epipedon that is 50 cm to 100 cm thick if the particle-size class is sandy throughout;

c. Do not have an epipedon that is >100 cm thick if the particle-size class is sandy throughout;

d. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

e. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are moist more than six-tenths of the time in half or more years in some part of the moisture control section (not necessarily the same part) when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, are moist in most years in some or all parts of the moisture control section for 180 or more days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

f. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are dry for more than 135 cumulative days in some part of the moisture control section when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, the soils are dry in some or all parts of the moisture control section for more than 90 days during a period when the soil temperature at a depth of 50 cm exceeds 8° C;

g. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist, of 3.5 or more in some part, or has a value, dry, that is more than one unit higher than the value, moist.

Aquic Kandiustalfs are like Typic Kandiustalfs except for a, with or without e.

Aquic Arenic Kandiustalfs are like Typic Kandiustalfs except for a and b.

Arenic Kandiustalfs are like Typic Kandiustalfs except for b.

Arenic Aridic Kandiustalfs are like Typic Kandiustalfs except for b and e.

Aridic Kandiustalfs are like Typic Kandiustalfs except for e.

Grossarenic Kandiustalfs are like Typic Kandiustalfs

Rhodic Kandiustalfs are like Typic Kandiustalfs except for g.

Udic Kandiustalfs are like Typic Kandiustalfs except for f.

Kanhaplustalfs

Definition

Kanhaplustalfs are the Ustalfs that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAC pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Have a clay distribution such that the content of clay decreases from its maximum amount by 20 percent or more within a depth of 150 cm from the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer;

3. Do not have plinthite that forms a continuous phase or constitutes more than half the volume of some subhorizon within 150 cm of the soil surface; and

4. Do not have a natric horizon or duripan.

Distinctions between Typic Kanhaplustalfs and other subgroups

Typic Kanhaplustalfs are the Kanhaplustalfs that

a. Do not have mottles that have chroma of 2 or less within 75 cm of the soil surface if the mottled horizon is saturated with water at sometime when the soil temperature at that depth is 5° C or higher or the soil has artificial drainage;

b. Do not have a lithic contact within 50 cm of the soil surface;

c. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are moist more than six-tenths of the time in half or more years in some part of the moisture control section (not necessarily the same part) when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, are moist in most years in some or all parts of the moisture control section for 180 or more days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

d. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are dry for more than 135 cumulative days in some part of the moisture control section when the soil

temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, the soils are dry in some or all parts of the moisture control section for more than 90 days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

e. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist, of 3.5 or more in some part, or has a value, dry, that is more than one unit higher than the value, moist.

Aquic Kanhaplustalfs are like Typic Kanhaplustalfs except for a.

Aridic Kanhaplustalfs are like Typic Kanhaplustalfs except for c.

Lithic Kanhaplustalfs are like Typic Kanhaplustalfs except for b with or without c.

Rhodic Kanhaplustalfs are like Typic Kanhaplustalfs except for e.

Udic Kanhaplustalfs are like Typic Kanhaplustalfs except for d."

Page 141, first column, line 51, Definition, change "1.25 m" to "150 cm"

Page 142, second column, line 15, Definition, change "1.25 m" to "150 cm"

Second column, Definition, item 3.b.(1), change to read: "...a depth of 150 cm from the soil surface, or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer, and"

Page 143, first column, distinctions between Typic Paleustalfs and other subgroups, item i., change to read: "...per 100 g clay (by 1N NH_4OAc pH 7) in the major part of the argillic horizon or the major part of the upper 100 cm of the argillic horizon if the argillic horizon is thicker than 100 cm;"

Item j., change to read: "...a value, moist, of 3.5 or more...."

Second column, change Oxic Paleustalfs to Kandic Paleustalfs and change to read: "Kandic Paleustalfs are like the Typic Paleustalfs except for i, with or without d or e, or both."

Ultic Paleustalfs, change to read: "Ultic Paleustalfs are like Typic Paleustalfs except for e and d." (delete rest of sentence)

615.38(a)

Page 144, second column, descriptions of subgroups, change Oxic Paleustalfs to Kandic Paleustalfs and change to read: "...a CEC (by 1N NH_4OAc pH 7) <24 meq per 100 g clay. Base saturation..."

Page 145, first column, Rhodic Paleustalfs, change to read: "....color value, moist, less than 3.5 and a..."

Page 145, second column, lines 13 and 37, change "1.25 m" to "150 cm"

Second column, Rhodustalfs definition, item 1, change to read: "...a value, moist, less than 3.5 and a..."

Second column, Rhodustalfs definition, item 4.a.(2), delete the word "and" at the end of this item.

Second column, Rhodustalfs definition, item 4.a., add item 4.a.(3) to read: "(3) There is less than 5 percent of the volume consisting of skeletans on faces of peds in the layer which the amount of clay decreases and there is less than 3 percent (absolute) increase in clay below the layer; and"

Page 146, first column, distinctions between Typic Rhodustalfs and other subgroups, item b., change to read: "...per 100 g clay (by 1N NH_4OAc pH 7) in the major part of the argillic horizon or the major part of the upper 100 cm of the argillic horizon if the argillic horizon is thicker than 100 cm; and"

Oxic Rhodustalfs, change to Kanhaplic Rhodustalfs and move to precede Lithic Rhodustalfs.

Description of subgroups, Oxic Rhodustalfs, change to Kanhaplic Rhodustalfs, and change to read: "...CEC is <24 meq per 100 g clay. They may have..." and move to precede Lithic Rhodustalfs.

Page 147, first column, line 7, item HDB. (Plinthoxeralfs), change "1.25 m" to "150 cm"

First column, key to great groups, Rhodoxeralfs, change to read: "...a value, moist, less than 3.5 and a..."

First column, item HDF (old HDE, changed Issue # 1 NSTH), change to the following"

"HDF. Other Xeralfs that have either a petrocalcic horizon whose upper boundary is within 150 cm of the soil surface, or:

1. Does not have a lithic or paralithic contact within 150 cm of the soil surface; and the argillic horizon

a. Has a vertical clay distribution such that the percentage of clay does not decrease from the maximum by as

much as 20 percent of that maximum throughout a depth of 150 cm from the soil surface or the horizon in which the clay decreases either has greater than 5 percent plinthite by volume or has skeletans or other evidences of clay eluviation; and

b. Have one or both of the following:

(1) A hue redder than 10YR and chroma, moist or dry, more than 4 in the matrix of at least the lower part of the argillic horizon;

(2) Common coarse mottles that have a hue of 7.5YR or redder or chroma, moist or dry, greater than 5 or both in at least the lower part of the argillic horizon, or

2. An argillic horizon that has a clayey particle-siz class in the upper part and an increase of at least 20 percent clay (absolute) within a vertical distance of 7.5 cm or at least 15 percent clay (absolute) within a vertical distance of 2.5 cm at the upper boundary; and there is no lithic or paralithic contact within 50 cm of the surface of the soil."

Palexeralfs, p. 151

Page 148, second column, line 2, change "1.25 m" to "150 cm"

Second column, item 3, change to read: "... a value, moist, of 3.5 or more..."

Page 150, second column, line 30, change "1.25 m" to "150 cm"

Page 151, first column, definition, item 1, change to the following:

1. Have one or more of the following:

a. A petrocalcic horizon that is in or below an argillic horizon but whose boundary is within 150 cm of the soil surface,

b. Do not have a lithic or paralithic contact within 150 cm of the surface and have both

(1) A clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent of the maximum throughout a depth of 150 cm from the soil surface, or the layer in which the clay decreases either has greater than 5 percent plinthite by volume or has skeletans or other evidences of clay eluviation, and

(2) One or more of the following in the argillic horizon

(a) A hue redder than 10YR and a chroma, moist or dry, that is more than 4 in the matrix of at leaast the lower part;

(b) Common coarse mottles that have a hue of 7.5YR or redder or chroma more than 5, moist or dry, or both in at least the lower part; or

c. An argillic horizon that has a particle-size class that is clayey in the upper part and has an increase of at least 20 percent clay (absolute) within a vertical distance of 7.5 cm or at least 15 percent clay (absolute) within 2.5

cm at the upper boundary and the soil does not have a lithic or paralithic contact within 50 cm of the surface."

Page 151, second column, line 6, item 3., change "1.25 m" to "150 cm"

Second column, item 4, change to read: "...a value, moist, of 3.5 or more..."

Page 153, first column, line 7, change "1.25 m" to "150 cm"

First column Rhodoxeralfs definition, change to read: "...a value, moist, of less than 3.5 and a..."

Page 156, second column, line 4, change to read: "...an argillic, kandic, or natric horizon..."

Second column, line 61, change to read: "..no argillic or kandic horizon or if there is an argillic or kandic horizon,..."

Page 180, first column, line 13, change to read: "...an argillic or kandic horizon..."

Second column, line 10, change to read: "...an argillic or kandic horizon..."

Page 227, second column, line 25, change to read: "...a spodic, argillic, kandic, natric..."

Page 228, second column, line 55, change to read: "...an argillic, kandic, or..."

Page 229, second column, line 47, change to read: "...an argillic, kandic, or natric horizon..."

Page 259, first column, distinctions between Typic Dystropepts and other subgroups, item f., change to read: "Have a CEC (by 1N NH_4OAc pH 7) of 24 or more meq per 100 g clay[23] in the major part of the soil below a depth of 25 cm but above 100 cm or a lithic or paralithic contact if one is

"Have a CEC (by 1N NH_4OAc pH 7) of 24 or more meq per 100 g clay[25] in the major part of the soil below a depth of 25 cm but above 100 cm or a lithic or paralithic contact if one is shallower than 100 cm."

Page 263, first column, distinctions between Typic Ustropepts and other subgroups, item e., change to read: "Have a CEC (by 1N NH_4OAc pH 7) of 24 or more meq per 100 g clay[26] in the major part of the soil below a depth of 25 cm but above 100 cm or a lithic or paralithic contact if one is shallower than 100 cm; and"

Description of subgroups, Oxic Ustropepts, change to read: "...have a cation exchange capacity (by 1N NH_4OAc pH 7) of less...".

Page 271, Second column, line 3, item 1., change to read: "...an argillic, kandic, or natric..."

Second column, line 9, item 2., change to read: "If there is no argillic, kandic, or natric horizon, have..."

Page 296, first column, distinctions between Typic Argiudolls and other subgroups, item e., change to read: "Have CEC (by 1N NH_4OAc pH 7) of 24 or more in the major part of the argillic horizon or the major part of the upper 100 cm of the argillic horizon if the argillic horizon is thicker than 100 cm."

Page 304, first column, distinctions between Typic Haplustolls and other subgroups, item k., change to read: "Have CEC (by 1N NH_4OAc pH 7) of 24 or more meq per 100 g clay in the major part of the soil below a depth of 25 cm but above 100 cm or a lithic or paralithic contact if one is shallower than 100 cm."

Page 323, second column. line 30, item 2., change to read: "...a spodic, argillic, or kandic horizon that..."

Page 336, first column, distinctions between Typic Fragiaquods and other subgroups, item f., change to read: "Do not have an argillic or kandic horizon."

First column, Description of subgroups, Typic Fragiaquods, last line, change to read: "...freeze. An argillic or kandic horizon...."

Second column, Description of subgroups, Alfic Fragiaquods, change to read: "Soils in this subgroup have an argillic or kandic horizon....In the United States, an argillic horizon..."

Distinctions between Typic Haplaquods and other subgroups, item b., change to read: "Do not have an argillic or kandic horizon..."

Page 337, first column, Distinctions between Typic Haplaquods and other subgroups, Alfic Haplaquods, change to read: "...in some part of the argillic or kandic horizon or have a..."

Alfic Arenic Haplaquods, change to read: "...in some part of the argillic or kandic horizon or have..."

Arenic Ultic Haplaquods (Soil Taxonomy Handbook issue # 7), change to read: "...throughout the argillic or kandic horizon..."

[redacted]

argillic or kandic horizon..."

Deacription of subgroups, Typic Haplaquods, change to read: "...or an argillic or kandic horizon..."

Second column, Deacription of aubgroupa, Typic Haplaquods, change to read: "...A lower sequum that has an argillic or kandic horizon...formed in a former argillic or kandic horizon..."

Alfic Haplaquods, change to read: "...have an argillic or kandic horizon...:

Alfic Arenic Haplaquods, change to read: "...have an argillic or kandic horizon..."

Arenic Ultic Haplaquods (Soil Taxonomy Handbook issue # 7), change to read: "...have an argillic or kandic horizon..."

Page 338, first column, Descriptions of subgroups, Ultic Haplaquods, change to read: "...have an argillic or kandic horizon..."

Second column, Distinctions between Typic Sideraquods and other subgroups, item c., change to read: "Do not have an argillic or kandic horizon."

Page 339, first column, Distinctions between Typic Sideraquods and other subgroups, Alfic Sideraquods, change to read: "...some part of the argillic or kandic horizon..."

Description of subgroups, Alfic Sideraquods, change to read: "...have an argillic or kandic horizon...in the argillic or kandic horizon..."

Distinctions between Typic Tropaquods and other subgroups, item c., change to read: "Do not have an argillic or kandic horizon underlying..."

Page 340, first column, Description of subgroups, Typic Tropaquods, change to read: "...An argillic or kandic horizon..."

Page 341, first column, Distinctions between Typic Cryohumods and other subgroups, item d., change to read: "Do not have an argillic or kandic horizon..."

Description of subgroups, Typic Cryohumods, change to read: "...Argillic or kandic horizons probably do not exist..."

Second column, Distinctions between Typic Haplohumods and other subgroups, item d., change to read: "Do not have an argillic or kandic horizon..."

Page 342, first column, Description of subgroups, Typic Haplohumods, change to read: "...that do not have an argillic or kandic horizon below..."

Arenic Ultic Haplohumods, change to read: "...In addition there is an argillic or kandic horizon below..."

Second column, Ultic Haplohumods, change to read: "...underlain by an argillic or kandic horizon with..."

Page 343, second column, Cryorthods, change to read: "...another sequum that has an argillic or kandic horizon."

Distinctions between Typic Cryorthods and other subgroups, item a., change to read: "Do not have an argillic or kandic horizon below..."

Description of subgroups, Typic Cryorthods, change to read: "...A second sequum that has and argillic or kandic horizon is..."

Page 344, first column, Description of subgroups, Boralfic Cryorthods, change to read: "...that has an argillic or kandic horizon..."

Second column, Distinctions between Typic Fragiorthods and other subgroups, item a., change to read: "Do not have an argillic or kandic horizon below..."

Alfic Fragiorthods, change to read: "...in some part of the argillic or kandic horizon or..."

Page 345, first column, Description of subgroups, Typic Fragiorthods, change to read: "...fixed on soils that do not have an argillic or kandic horizon, do not have..."

Alfic Fragiorthods, change to read: "These soils have an argillic or kandic horizon that..."

second column, Haplorthods, change to read: "...that has an argillic or kandic horizon (plate 7B)..."

Page 346, first column, Distinctions between Typic Haplorthods and other subgroups, item a., change to read: "Do not have an argillic or kandic horizon below..."

Second column, Distinctions between Typic Haplorthods and other subgroups, Alfic Haplorthods, change to read: "...and the argillic or kandic horizon either..."

Aqualfic Haplorthods, change to read: "...and the argillic or kandic horizon either..."

Ultic Haplorthods, change to read: "...and the argillic or kandic horizon has..."

Description of subgroups, Typic Haplorthods, change to read: "...A lower aequum that has an argillic or kandic horizon is..."

Page 347, first column, Alfic Haplorthods, change to read: "...there is an argillic or kandic horizon that..."

Aqualfic Haplorthods, change to read: "...there is an argillic or kandic horizon that..."

Second column, Ultic Haplorthods, change to read: "...there is an argillic or kandic horizon and..."

Page 349, first column, lines 1, 2, and 3, change to read: "...mid to low latitudes that have an argillic or kandic horizon with few bases. The..."

Second column, lines 1, 4, 10, 15, 23, 25, and 35, change to read: "...argillic or kandic horizon..."

Page 350, first column, lines 13, 20, 24, 29, 46, 49, 53, and 55, change to read: "...argillic or kandic horizon..."

Second column, lines 3, 12, 15, 19, 21, 30, 35, and 59, change to read: "...an argillic or kandic horizon..."

Page 351, first column, lines 2, 4, 11, 36, 37, 54, and 60, change to read: "...argillic or kandic horizon..."

Second column, line 1, change to read: "...argillic or kandic horizon..."

Second column, line 7, change "1.25m" to "1.5m"

Page 351, key to great groups, following FAC, add:

"FAD. Other Aquults that

1. Have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;
2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface; and
3. Have a clay distribution such that the percentage of clay does not decrease from its maximum by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Kandiaquults, p. 352

FAE. Other Aquults that have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm.

Kanhaplaquults, p. 352

FAF. Other Aquults that have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface and do not have a lithic or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Paleaquults, p. 353

Key to great groups, delete FAD and substitute new FAF, delete FAE and change FAF to FAG and FAG to FAH

Page 352, first column, line 37, change "1.25 m" to "150 cm"

Page 352, second column,preceding Ochraquults, add:

"Kandiaquults

Definition

Kandiaquults are the aquults that

1. Have a CEC <16 meq per 100 g clay (by 1N NH4 OAc ph 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2.Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface;

3.Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of [illegible]

4. Do not have plinthite that forms a continuous phase or constitutes more than half the volume of some subhorizon within 150 cm of the soil surface;

5. Do not have a fragipan; and

6. Do not have an abrupt textural change between the epipedon or the albic horizon and the argillic horizon and slow or very slow hydraulic conductivity in the argillic horizon.

Distinctions between Typic Kandiaquults and other subgroups

Typic Kandiaquults are the Kandiaquults that

a. Do not have a subhorizon that has dominant chroma of 3 or more within 75 cm of the soil surface;

b. Do not have an epipedon that is 50 cm to 100 cm thick if the particle-size class is sandy throughout;

c. Do not have an epipedon that is >100 cm thick if the particle-size class is sandy throughout;

d. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

e. Have an ochric epipedon; and

f. Have an ECEC (sum of bases plus 1N KCL extractable AL) of more than 1.5 meq per 100 g clay in all subhorizons to a depth of 150 cm below the soil surface.

Acric Kandiaquults are like Typic Kandiaquults except

for d.

Umbric Kandiaquults are like Typic Kandiaquults except for e.

Kanhaplaquults

Definition

Kanhaplaquults are the Aquults that

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Have a clay distribution such that the percentage of clay decreases from its maximum amount by 20 percent or more within a depth of 150 cm from the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer;

3. Do not have plinthite that forms a continuous phase or constitutes more than half the volume of some subhorizon within 150 cm of the soil surface;

4. Do not have a fragipan; and

5. Do not have an abrupt textural change between the epipedon or the albic horizon and the argillic horizon and slow or very slow hydraulic conductivity in the argillic

subgroups

except for c, with or without b.

Umbric Kanhaplaquults are like Typic Kanhaplaquults except for a."

Page 353, first column, definition Ochraquults, item 1., change to read: "Do not have a fragipan or kandic horizon;"

Definition Ochraquults, delete item 3. and renumber 4, 5, and 6 as 3, 4, and 5.

New item 5., change to read: "Have a clay distribution such that the percentage of clay decreases from its maximum by 20 percent or more of the maximum within a depth of 150 cm below the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete item 6.b.)

First column, line 15, change "1.25 m" to "150 cm"

Second column, definition Paleaquults, item 1., change to read: "Do not have a fragipan or kandic horizon..."

Definition Paleaquults, item 3., change to read: "...depth of 150 cm from the soil surface, or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer."

Definition Paleaquults, delete item 4.

Second column, line 41, change "1.25 m" to "150 cm"

Page 354, First column, line 56, change "<1.25 m" to "<150 cm"

[illegible]

Second column, Distinction between Typic and Oxic Plinthaquults, change to read: "Distinctions between Typic

Page 355, first column, delete: " Tropaquults..."

Second column, line 16, change "1,25 m" to "150 cm"

Second column, definition Umbraquults, item 5, change to read: "Have a clay distribution such that the percentage of clay decreases from its maximum by 20 percent or more of th maximum within a depth of 150 cm below the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete item 5.b.)

Second column, definition Umbraquults, delete item 4 and renumber 5 as 4.

Second column, line 31, change to read: "...the argillic or kandic horizon."

Page 356, first column, lines 2 and 10, change to read: "the argillic or kandic horizon..."

First column, Key to great groups, delete all of "FBB" and change "FBC" to "FBB"

First column, line 29, change "1.25 m" to "150 cm"

First column, delete all of FBD and substitute the following for FBC and FBD:

"FBC. Other Humults that:

1. Have a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;
2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface; and
3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Kandihumults, p. 357

FBD. Other Humults that have a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic

or kandic horizon if these horizons are thicker than 100 cm.
Kanhaplohumults, p. 357"

First column, Definition of Haplohumults, item 1.,

1. Mottles that have a color value, moist, of 4 or more, and chroma, moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation of iron; and

2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or more or there is artificial drainage;

b. Have an udic moisture regime;

c. Do not have a layer in the upper 75 cm that has

[redacted]

thick, that has a bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction, and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-bar water of >1.5 and more exchange acidity than the sum of bases plus KCL-extractable aluminum;

d. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

e. Have a hue redder than 10YR in all parts of the soil above a depth of 75 cm that have a color value, moist, of 4 or more if there are mottles of high chroma within that depth and if the hue becomes redder with depth within 100 cm of the soil surface; and

f. Do not have an anthropic epipedon.

Andic Kandihumults are like Typic Kandihumults except for c.

Andic Epiaquic Kandihumults are like Typic Kandihumults except for c and e.

Andic Ustic Kandihumults are like Typic Kandihumults except for b and c and they have an ustic moisture regime.

Anthropic Kandihumults are like Typic Kandihumults except for f.

Epiaquic Kandihumults are like Typic Kandihumults except for e.

Plinthic Kandihumults are like Typic Kandihumults except for d.

Ustic Kandihumults are like Typic Kandihumults except for b and they have an ustic moisture regime.

Kanhaplohumults

Definition

Kanhaplohumults are the Humults that:

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major

less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer;

3. Do not have a sombric horizon within 150 cm of the soil surface; and

4. Do not have plinthite that forms a continuous phase or that constitutes more than 50 percent of the volume of some subhorizon within 150 cm of the soil surface.

Distinctions between Typic Kanhaplohumults and other subgroups

Typic Kanhaplohumults are the Kanhaplohumults that

a. Do not have the following combination of characteristics in the upper 25 cm or more of the argillic or kandic horizon;

1. Mottles that have a color value, moist, of 4 or more and chroma, moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation of iron; and

2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or higher or there is artificial drainage;

b. Do not have a lithic contact within 50 cm or the mineral soil surface;

c. Have an udic moisture regime;

d. Do not have a layer in the upper 75 cm that has texture finer than loamy fine sand, that is as much as 18 cm thick, that has bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction, and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-bar water of >1.5 and more exchange acidity than the sum of bases plus KCL-extractable aluminum;

e. Have a hue redder than 10YR in all parts of the soil above a depth of 75 cm that have a color value, moist, of 4 or more if there are mottles of high chroma above that depth and if the hue becomes redder with depth within 100 cm of the soil surface; and

f. Do not have an anthropic epipedon.

Andic Kanhaplohumults are like Typic Kanhaplohumults except for d, with or without e or f.

Andic Ustic Kanhaplohumults are like Typic Kanhaplohumults except for c and d, with or without e or f, and they have an ustic moisture regime.

Anthropic Kanhaplohumults are like Typic Kanhaplohumults except for f.

Aquic Kanhaplohumults are like Typic Kanhaplohumults except for a or for a and e.

Epiaquic Kanhaplohumults are like Typic Kanhaplohumults except for e.

Lithic Kanhaplohumults are like Typic Kanhaplohumults

except for b with or without any of a, c, d, e, or f.

Ustic Kanhaplohumults are like Typic Kanhaplohumults except for c and they have an ustic moisture regime."

Pages 357-358, Delete: "Palehumults..."

Pages 358-360, Delete: "Tropohumults..."

Page 360, first column, lines 51, 54, and 55, change to read: "...argillic or kandic horizon..."

Second column, line 13, change to read: "...the argillic or kandic..."

Second column, Key to great groups, substitute the following:

"Key to great groups

FCA. Udults that have plinthite that forms a continuous phase or constitutes more than half the volume in some subhorizon within 150 cm of the soil surface.

Plinthudults, p. 366

FCB. Other Udults that have a fragipan in or below the argillic or kandic horizon.

Fragiudults, p. 360

FCC. Other Udults that

1. Have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface: and

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer

FCE. Other Udults that have a clay distribution such that the percentage of clay does not decrease from its maximum amount by more than 20 percent within 150 cm of the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Paleudults, p. 364

FCF. Other Udults that have:

1. An epipedon that has a color value, moist, less than 3.5 in all parts; and

2. An argillic horizon that has a color value, dry, less than 5 and not more than 1 unit higher than the value, moist.

Rhodudults, p. 367

FCG. Other Udults.

Hapludults, p. 362"

Page 360, second column, line 48, change to read: "...the argillic or kandic horizon..."

Page 361, first column, lines 3, 15, 18, and 20, change to read: "...argillic or kandic horizon..."

First column, Distinctions between Typic Fragiudults and other subgroups, item a.(1), change to read: "(1) Have an argillic or kandic horizon above the fragipan; and

Second column, Description of subgroups, Typic Fragiudults, first paragraph, change to read: "The central concept or typic subgroup of Fragiudults is fixed on soils that have an argillic or kandic horizon that is underlain by a fragipan..."

Second column, line 60, change to read: "...an argillic or kandic horizon..."

Page 362, first column, Glossaquic Fragiudults, first paragraph, lines 4 and 5, change to read: "... Also they lack an argillic or kandic horizon above the fragipan..."

Glossic Fragiudults, lines 1 and 2, change to read: "These soils lack an argillic or kandic horizon above the fragipan..."

Second column, Definition Hapludults, item 1., change to read: "Do not have a fragipan or kandic horizon;"

Definition Hapludults, item 2, change "1.25 m" to "150 cm"

Definition Hapludults, item 5, change to read: "Have a clay distribution with depth...within 150 cm of the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete remainder of item 5.a. and all of 5.b.)

Definition Hapludults, delete item 4., and renumber 5 as 4.

Page 364, first column, preceding Paleudults, add:

"Kandiudults

Definition

Kandiudults a the Udults that:

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface;

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer;

4. Do not have plinthite that forms a continuous phase or constitutes more than half the volume in some subhorizon within 150 cm of the soil surface; and

5. Do not have a fragipan in or below the argillic or kandic horizon.

Distinctions between Typic Kandiudults and other subgroups

Typic Kandiudults are the Kandiudults that:

a. Do not have the following combination of characteristics in the upper 75 cm of the soil if the chroma throughout the upper 75 cm is not controlled by uncoated sand grains; or if the chroma throughout the upper 75 cm is controlled by uncoated sand grains, do not have the following combination of characteristics throughout the upper 12.5 cm of the argillic or kandic horizon:

1. Mottles that have a color value, moist, of 4 or more and chroma, moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation of iron; and

2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or higher, or there is artificial drainage;

b. Do not have an epipedon that is 50 cm to 100 cm thick if the particle-size class is sandy throughout;

c. Do not have an epipedon that is >100 cm thick if the particle-size class is sandy throughout;

d. Do not have a subhorizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

e. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist, of 3.5 or more or has a value, dry, that is more than 1 unit higher than the value, moist;

f. Do not have a layer in the upper 75 cm that has texture finer than loamy fine sand, that is as much as 18 cm thick, that has bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction, and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-bar water of >1.5 and more exchange acidity than the sum of bases plus KCL extractable aluminum;

g. Have a hue redder than 10YR in all parts of the soil above a depth of 75 cm that have color value, moist, of 4 or more if there are mottles of high chroma within that depth and if the hue becomes redder with depth within 100 cm of the soil surface;

h. Have an ECEC (sum of bases plus 1N KCL extractable Al) of more than 1.5 meq per 100 g clay in all subhorizons to a depth of 150 cm below the soil surface; and

i. Do not have a sombric horizon within 150 cm of the soil surface.

Acric Kandiudults are like Typic Kandiudults except for h, with or without f.

Acric Plinthic Kandiudults are like Typic Kandiudults except for d and h, with or without f.

Andaquic Kandiudults are like Typic Kandiudults except for a and f.

Andic Kandiudults are like Typic Kandiudults except for f.

Aquic Kandiudults are like Typic Kandiudults except for a.

Aquic Arenic Kandiudults are like Typic Kandiudults except for a and b.

Arenic Kandiudults are like Typic Kandiudults except for b.

Arenic Plinthaquic Kandiudults are like Typic Kandiudults except for a, b, and d.

Arenic Plinthic Kandiudults are like Typic Kandiudults except for b and d.

Arenic Rhodic Kandiudults are like Typic Kandiudults except for b and e.

Epiaquic Kandiudults are like Typic Kandiudults except for g.

Grossarenic Kandiudults are like Typic Kandiudults

except for c or for a and c.

Grossarenic Plinthic Kandiudults are like Typic Kandiudults except for a and d.

Plinthaquic Kandiudults are like Typic Kandiudults except for a and d.

Plinthic Kandiudults are like Typic Kandiudults except for d.

Rhodic Kandiudults are like Typic Kandiudults except for e.

Sombric Kandiudults are like Typic Kandiudults except for i.

Kanhapludults

Definition

Kanhapludults are the Udults that:

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Have a clay distribution such that the percentage of clay decreases from its maximum amount by 20 percent or more within a depth of 150 cm from the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer;

3. Do not have plinthite that forms a continuous phase or constitutes more than half the volume in some subhorizon within 150 cm of the soil surface; and

4. Do not have a fragipan in or below the argillic or kandic horizon.

Distinctions between Typic Kanhapludults and other subgroups

Typic Kanhapludults are the Kanhapludults that:

a. Do not have the following combination of characteristics in the upper 75 cm of the soil if the chroma throughout the upper 75 cm is not controlled by the uncoated sand grains; or if the chroma throughout the upper 75 cm is controlled by uncoated sand grains, do not have the following combination of characteristics throughout the upper 12.5 cm of the argillic or kandic horizon:

1. Mottles that have a color value, moist, of 4 or more and chroma, moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation or iron; and

2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or higher or there is artificial drainage;

b. Do not have an epipedon that is ≥50 cm thick if the particle-size class is sandy throughout;

c. Do not have a horizon within 150 cm of the soil

surface that has >5 percent plinthite by volume;

d. Do not have a lithic contact within 50 cm of the soil surface;

e. Have a hue redder than 10YR in all parts of the soil above a depth of 75 cm that have color value, moist, of 4 or more if there are mottles of high chroma within that depth and if the hue becomes redder with depth within 100 cm of the soil surface;

f. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist, of 3 or more in some part or has a value, dry, that is more than one unit higher than the value, moist;

g. Do not have a layer in the upper 75 cm that has texture finer than loamy fine sand, that is as much as 18 cm thick, that has bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-bar water of >1.5 and more exchange acidity than the sum of bases plus KCl-extractable aluminum; and

h. Have an ECEC (sum of bases plus 1N KCl extractable Al) of more than 1.5 meq per 100 g clay in all subhorizons to a depth of 150 cm below the soil surface.

Acric Kanhapludults are like Typic Kanhapludults except for h, with or without any of c, e, or g.

Andic Kanhapludults are like Typic Kanhapludults except for g, with or without e.

Aquic Kanhapludults are like Typic Kanhapludults except for a.

Arenic Kanhapludults are like Typic Kanhapludults except for b.

Arenic Plinthic Kanhapludults are like Typic Kanhapludults except for b and c.

Epiaquic Kanhapludults are like Typic Kanhapludults except for e.

Lithic Kanhapludults are like Typic Kanhapludults except for d, with or without a, e, f, or g.

Plinthaquic Kanhapludults are like Typic Kanhapludults except for a and c, with or without g.

Plinthic Kanhapludults are like Typic Kanhapludults except for c, with or without g.

Rhodic Kanhapludults are like Typic Kanhapludults except for f."

Page 364, first column, Definition Paleudults, item 1., change to read: "Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by >20 percent of the maximum within 150 cm of the soil surface or the layer in which the clay percentage decreases

least 3 percent (absolute) increase in clay below the layer." (Delete item 1.a. and remainder of 1.b.)

First column, item 2., Definition Paleudults, change to read: "Do not have a fragipan or kandic horizon; and"

Page 366, second column, line 61, change to read: "...the argillic or kandic horizon..."

Page 367, first column, lines 8 and 38, Definition Plinthudults and Rhodudults, change "1.25 m" to "150 cm"

First column, Definition Rhodudults, item 3., change to read: "Do not have a fragipan or kandic horizon;"

First column, Definition Rhodudults, item 5., change to read: "Have a clay distribution with depth such that the percentage of clay...within a depth of 150 cm below the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete remainder of 5.a. and all of 5.b.)

Pages 367-369, delete: "Tropudults..."

Page 369 second column, lines 9 and 26, change to read: "...argillic or kandic horizon..."

Page 369, Key to great groups, substitute the following:

"Key to great groups

FDA. Ustults that have plinthite that forms a continuous phase or that constitutes more than half the volume of some subhorizon within 150 cm of the soil surface.
Plinthustults, p. 371

FDB. Other Ustults that

1. Have a CEC $\leq$16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC $\leq$12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;
2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface; and
3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent

(absolute) increase in clay below the layer.

Kandiustults, p. 371

FDC. Other Ustults that have a CEC ≤16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm.

Kanhaplustults, p. 371

FDD. Other Ustults that have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent of that maximum within 150 cm of the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer.

Paleustults, p. 371

FDE. Other Ustults that have:

1. An epipedon that has a color value, moist, less than 3.5 in all parts; and
2. An argillic horizon that has a color value, dry, less than 5 and not more than 1 unit higher than the value, moist.

Rhodustults, p. 371

FDF. Other Ustults.

Haplustults, p. 369"

Page 369, second column, Haplustults, delete: "or have 10 percent...or both,"

Page 370, first column, Definition Haplustults, item 1., change to read: "Do not have a fragipan or kandic horizon;"

First column, Definition Haplustults, item 2., change "1.25 m" to "150 cm"

First column, Definition Haplustults, item 4., change to read: "Have a clay distribution with depth such that...within 150 cm of the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete remainder of 4.a. and all of 4.b.)

Page 370, second column, Distinctions between Typic Haplustults and other subgroups, item h., change to read: "h. Have a CEC of 24 or more meq per 100 g clay (by 1N NH_4OAc pH

7) in the major part of the argillic horizon or the major

part of the upper 100 cm of the argillic horizon if the argillic horizon is thicker than 100 cm."

Oxic Haplustults, change to Kanhaplic Haplustults and move to precede Lithic Haplustults.

Page 371, first column, change Oxic Haplustults to Kanhaplic Haplustults and move to precede Lithic Haplustults.

Page 371, first column, preceding Paleustults, add:

"Kandiustults

Definition

Kandiustults are the Ustults that:

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the soil surface;

3. Have a clay distribution such that the percentage of clay does not decrease from its maximum amount by as much as 20 percent within a depth of 150 cm from the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer; and

4. Do not have plinthite that forms a continuous phase or constitutes more than half the volume of some subhorizon within 150 cm of the soil surface.

Distinctons between Typic Kandiustults and other subgroups

Typic Kandiustults are the Kandiustults that:

a. Do not have the following combination of characteristics in the upper 75 cm of the soil if the chroma throughout the upper 75 cm is not controlled by uncoated sand grains; or if the chroma throughout the upper 75 cm is controlled by uncoated sand grains, do not have the following combination of characteristics throughout the upper 12.5 cm of the argillic or kandic horizon:

1. Mottles that have a color value, moist, of 4 or more and chroma, moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation of iron; and

2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or higher or there is artificial drainage;

b. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

c. Do not have an epipedon that is ≥50 cm thick if the particle-size class is sandy throughout;

d. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist, of 3.5 or more in some part, or has a value, dry, that is more than one unit higher than the value, moist;

e. Do not have a layer in the upper 75 cm that has texture finer than loamy fine sand, that is as much as 18 cm thick, that has a bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction, and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-water of >1.5 and more exchange acidity than the sum of bases plus KCl-extractable aluminum;

f. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are moist more than six-tenths of the time in half or more years in some part of the moisture control section (not necessarily the same part) when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, are moist in most years in some or all parts of the moisture control section for 180 or more days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

g. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are dry for more than 135 cumulative days in some part of the moisture control section when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, the soils are dry in some or all parts of the moisture control section for more than 90 days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

h. Have an ECEC (sum of bases plus KCl extractable Al) of more than 1.5 meq per 100 g clay in all subhorizons to a depth of 150 cm below the soil surface.

Acric Kandiustults are like Typic Kandiustults except for h with or without a, b, or d.

Andic Kandiustults are like Typic Kandiustults except for e, with or without b.

Andic Udic Kandiustults are like Typic Kandiustults except for e and g.

Aquic Kandiustults are like Typic Kandiustults except for a.

Arenic Kandiustults are like Typic Kandiustults except for c.

Arenic Plinthic Kandiustults are like Typic Kandiustults except for b and c.

Aridic K ndiustults are like Typic Kandiustults except

for f.

Plinthic Kandiustults are like Typic Kandiustults except for b.

Rhodic Kandiustults are like Typic Kandiustults except for d.

Udic Kandiustults are like Typic Kandiustults except for g.

Kanhaplustults

Definition

Kanhaplustults are the Ustults that:

1. Have a CEC <16 meq per 100 g clay (by 1N NH_4OAc pH 7) and an ECEC ≤12 meq per 100 g clay (sum of bases extracted with 1N NH_4OAc pH 7 plus 1N KCl extractable Al) in the major part of the argillic or kandic horizon or the major part of the upper 100 cm of the argillic or kandic horizon if these horizons are thicker than 100 cm;

2. Have a clay distribution such that the percentage of clay decreases from its maximum amount by 20 percent or more within a depth of 150 cm from the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer; and

3. Do not have plinthite that forms a continuous phase or constitutes more than half the volume of some subhorizon within 150 cm of the soil surface.

Distinctions between Typic Kanhaplustults and other subgroups

Typic Kanhaplustults are the Kanhaplustults that

a. Do not have a lithic contact within 50 cm of the mineral soil surface;

b. Do not have the following combination of characteristics in the upper 75 cm of the soil if the chroma throughout the upper 75 cm is not controlled by uncoated sand grains; or if the chroma throughout the upper 75 cm is controlled by uncoated sand grains, do not have the following combination of characteristics throughout the upper 12.5 cm of the argillic or kandic horizon:

1. Mottles that have a color value, moist, of 4 or more and chroma. moist, of 2 or less accompanied by mottles of higher chroma that are due to segregation of iron; and

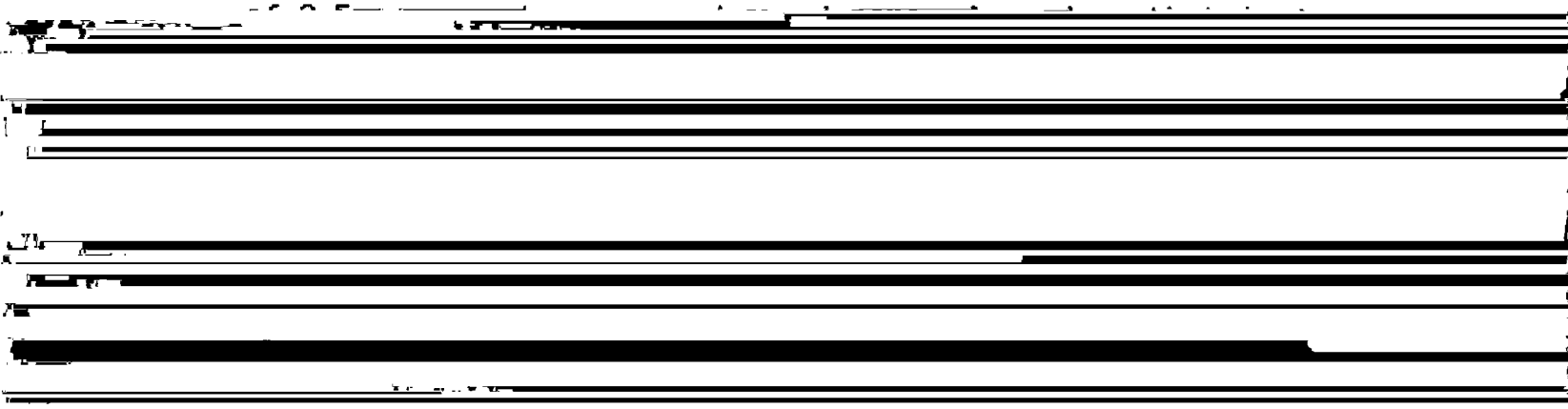
2. Saturation with water in the mottled zone at some time of year when the soil temperature in that zone is 5° C or higher or there is artificial drainage;

c. Have a hue redder than 10YR in all parts of the soil above a depth of 75 cm that have a color value, moist, of 4 or more if there are mottles of high chroma above that depth and if the hue becomes redder with depth within 100 cm of the soil surface;

d. Do not have a horizon within 150 cm of the soil surface that has >5 percent plinthite by volume;

e. Do not have an epipedon that is ≥50 cm thick if the particle-size class is sandy throughout;

f. Have an argillic or kandic horizon that has a color hue of 5YR or yellower in some part, or has a value, moist,



more than one unit higher than the value, moist;

g. Do not have a layer in the upper 75 cm that has texture finer than loamy fine sand, that is as much as 18 cm thick, that has bulk density (at 1/3-bar water tension) of 0.95 g per cubic centimeter or less in the fine-earth fraction, and that has either of the following:

1. A ratio of measured clay to 15-bar water (percentages) of 1.25 or less; or

2. A ratio of CEC (pH 8.2) to 15-bar water of >1.5 and more exchange acidity than the sum of bases plus KCl-extractable aluminum;

h. Have an ECEC (sum of bases KCl-extractable Al) of more than 1.5 meq per 100 g clay in all subhorizons to a depth of 150 cm below the soil surface; and

i. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are moist more than six-tenths of the time in half or more years in some part of the moisture control section (not necessarily the same part) when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, are moist in most years in some or all parts of the moisture control section for 180 or more days during a period when the soil temperature at a depth of 50 cm exceeds 8° C; and

j. When neither irrigated nor fallowed to store moisture:

1. If the soil temperature regime is mesic or thermic, are dry for more than 135 cumulative days in some part of the moisture control section when the soil temperature at a depth of 50 cm exceeds 5° C; or

2. If the soil temperature regime is hyperthermic, isomesic, or warmer, the soils are dry in some or all parts of the moisture control section for more than 90 days during a period when the soil temperature at a depth of 50 cm exceeds 8° C;.

Acric Kanhaplustults are like Typic Kanhaplustults except for h, with or without any of c, d, or g.

Andic Kanhaplustults are like Typic Kanhaplustults except for g. with or without c or d or both.

except for i.

Epiaquic Kanhaplustults are like Typic Kanhaplustults except for c.

Lithic Kanhaplustults are like Typic Kanhaplustults except for a.

Plinthic Kanhaplustults are like Typic Kanhaplustults except for d.

Rhodic Kanhaplustults are like Typic Kanhaplustults except for f.

Udic Kanhaplustults are like Typic Kanhaplustults except for l."

Page 371, first column, Definition Paleustults, item 1., change to read: "Have a clay distribution such that the percentage of clay...within 150 cm of the soil surface or the layer in which the clay percentage decreases by more than 20 percent has at least 5 percent of the volume consisting of skeletans on faces of peds and there is at least 3 percent (absolute) increase in clay below the layer." (Delete remainder of item 1.)

Second column, Definition paleustults, item 3., change to read: "Do not have a fragipan or kandic horizon."

Second column, lines 1, 15, and 42, change "1.25 m" to "150 cm"

Second column, Definition Rhodustults, item 4., change to read: "Have a clay distribution with depth such that...within 150 cm of the soil surface, and the layer in which the percentage of clay is less than the maximum has less than 5 percent of the volume consisting of skeletans on faces of peds or there is less than 3 percent (absolute) increase in clay below the layer." (Delete remainder of item 4.)

Second column, Definition Rhodustults, add item "5." to read: "5. Do not have a fragipan or a kandic horizon."

Page 385, first column, Control section for particle-size classes or their substitutes, item B., lines 1 and 3, change to read: "...argillic or kandic horizon..."

Item C., line 2, change to read: "...an argillic or kandic horizon..."

Item C.1., lines 4, 6, and 7, change to read: "...argillic, kandic, or natric horizon..."

Item C.2., lines 3 and 5, change to read: "...argillic, kandic, or natric horizon..."

Second column, item C.3., lines lines 2, 4, and 7, change to read: "...argillic, kandic, or natric horizon..."

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Second column, item D., line 2, change to read: "...argillic, kandic, or natric horizon..."

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